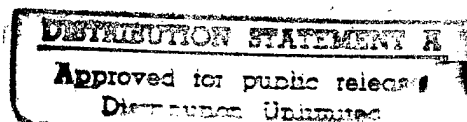


JPRS-UMS-84-006

20 August 1984

# USSR Report

MATERIALS SCIENCE AND METALLURGY



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# USSR REPORT

## MATERIALS SCIENCE AND METALLURGY

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## ALUMINUM AND ITS ALLOYS

### ACTIVATED ALUMINUM ALLOY FOR GENERATING HYDROGEN FUEL

Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 25 May 84 p 4

[Article by V. Ryndin]

[Text] Scientists believe that a successful solution of the energy problem depends in large measure on the utilization of hydrogen as a fuel. A new exhibit on hydrogen energy has opened at the USSR Academy of Sciences' "Physics" pavillion at the USSR Exhibition of National Economic Achievements.

Here various hydrogen units and motor vehicle and tractor engines running on the gaseous fuel are being demonstrated.

Scientists of the Kazakh Academy of Sciences' Institute of Organic Catalysis and Electrochemistry have submitted to the exhibit a new aluminum-based alloy activated by additions of rare metals and tin. When this alloy reacts with water, hydrogen is formed. Only the aluminum dissolves, while the activators settle at the bottom of the reactor and can be used for the production of new alloy.

The innovation has passed laboratory tests and its commercial testing has now begun at the Ukrainian Academy of Sciences' Institute of Machine-Building Problems.

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## MHD TECHNOLOGY IN ALUMINUM CASTING

Moscow PRAVDA in Russian 6 Jun 84 p 2

[Article by I. Kalinichenko, correspondent, Irkutsk]

[Excerpt] At the Bratsk Aluminum Plant, the decision was made to have a magnetic field do the job of foundry workers. Scientists were enlisted for this project. Associates of the Latvian Academy of Sciences' Institute of Physics developed magnetohydrodynamic units for the Siberian plant.

Last year, a MHD unit made it possible to free five persons from heavy work at the plant. Labor productivity doubled in this section. With the aid of the magnetic field, the alloy silumin is obtained in only three hours.

Specialists of the Irkutsk affiliate of the All-Union Scientific Research and Design Institute of the Aluminum, Magnesium and Electrode Industry are convinced that MHD technology has a bright future. However, this will necessitate the development of new MHD technology for different types of casting facilities, with their specific features taken into account.

The management of the aluminum plant has given Gennadiy Aleksandrovich Pakhomov, deputy head of an electrolysis shop, the assignment of heading a comprehensive program for retooling the whole plant's casting facilities. He first became familiar with MHD technology 10 years ago, when he headed one of the plant's casting departments. At that time, researchers of the Latvian Academy of Sciences' Institute of Physics were proposing a very attractive idea--automating one of the processes involved in the continuous pouring and rolling of metal with the aid of a MHD unit. The project was only partially successful, however. It was two years ago that E. Isidorov, the developer of the magnetohydrodynamic pumps that are now in operation, came to the Angara Valley from the same institute. He and his comrades promised to help install and master these new pumps. The science associates of the Institute of Physics did as they promised, installing each unit and putting it into operation.

The use of such mechanisms now is planned at the Krasnoyarsk and Novokuznetsk aluminum plants. This year, the All-Union production association "Soyuz-aluminiy" held a conference in Krasnoyarsk at which prospects were outlined for employing this progressive technology in the country's aluminum industry.

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## STUDY OF SIZE FACTOR EFFECT ON LOW-CYCLE FATIGUE OF ALUMINUM ALLOYS

Kiev PROBLEMY PROCHNOSTI in Russian No 5, May 84  
(manuscript received 4 Aug 83) pp 18-20

KAPLINSKIY, A. L., Institute of Problems of Strength, UkSSR Academy of Sciences, Kiev

[Abstract] The range of thickness changes in thin materials used in cryogenic technology for pressurized containers and shipping vessels for liquified gases is of importance due to the need to determine useful life and dependability of such containers. The present article reports on study of AMg6 and AMnS alloys of 30 x 6 x 2.5 mm and 100 x 30 x 10 mm to determine size factors in structural strength of welded-seam containers. The author measured fatigue, plasticity and relative contraction. Results indicated that the alloy AMg6 was more durable than AMnS. The durability of large welded specimens at both room temperature of 293° K and the temperature of liquid nitrogen (77°K) decreased by 12-15% in the quasistatic and fatigue failure ranges. These results should be taken into consideration when designing containers for cryogenic uses. Figures 2; references 5: all Russian.  
[115-12131]

## ANALYSIS AND TESTING

### PORTABLE ELECTROMAGNETIC FLAW DETECTOR FOR METAL PRODUCTS

Frunze SOVETSKAYA KIRGIZIYA in Russian 26 Jun 84 p 3

[Article by K. Chavaga]

[Excerpt] A versatile electromagnetic flaw detector which has been developed by associates of the Ukrainian Academy of Sciences' Physical-Mechanical Institute readily detects metal fatigue and hidden flaws inside metal structures.

The instrument operates on the basis of the nondestructive flaw-detection method. As its sensor approaches the surface of the structure that is to be inspected, eddy currents that are sent out penetrate the metal and instantly report the presence of dangerous cracks, various pores and corrosion damage which the eye cannot see. Images of these flaws appear on the screen of a cathode-ray tube and are accompanied by a sound signal.

Tests made in industrial conditions have shown that the materials with different electric conductivities can be inspected, even beneath a multi-layered casing as thick as 5 millimeters, thanks to the instrument's wide range of frequencies.

The L'vov scientists' development will find broad use in machine building, instrument building and civil aviation. The new instruments will permit high-speed inspection of production processes and heighten the reliability of products of industry. The versatile electromagnetic flaw detectors have been put into production at the institute's experimental plant.

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## C.A.T. SCANNER FOR DETECTING FLAWS IN METALS

Moscow IZVESTIYA in Russian 7 Jul 84 p 1

[Article by Z. Kudrya]

[Excerpt] A computer tomograph which has been developed by the "Spektr" research and production association in Moscow makes it possible to see the invisible.

This instrument is intended for finding microscopic cracks in metal. It is capable of peering into very thin wire as well as into the heart of a powerful turbine.

"A hundred thousand x-ray beams are directed at different angles into the product that is being checked," said Doctor of Technical Sciences V. Klyuyev, general director of "Spektr", explaining the tomograph's operating principle. "Detectors capture the rays, convert them into electric signals and transmit them to a computer. The computer, which performs 100 million operations a second, processes this information and reproduces the object on the screen in the form of a two-dimensional color image. The tomograph's sensitivity is as high as 0.006 percent, whereas the maximum sensitivity in conventional radiography is 1-2 percent."

More than 10 types of technical diagnostic instruments have been developed at the "Spektr" association, including laser, ultrasonic, gamma-ray and x-ray instruments.

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## COATINGS

### CORROSION RESISTANT GLASS COATING FOR METALS

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 23 May 84 p 2

[Article by G. Namtalashvili, correspondent (Tbilisi)]

[Text] Scientists of the Georgian Polytechnical Institute have proposed coating metal with a special glass so that it can acquire corrosion-resistant properties. The scientists have developed a process for producing such glass from a mixture of various by-products of mining industry. The lining of the inner surfaces of tanks used in the chemical industry with the Tbilisi glass has begun at the "Khim mash" (chemical machinery) plant in Poltava.

The scientists have proposed manufacturing from the same by-products a glass for soldering metal, ceramics and other materials.

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CSO: 1842/119

COMPOSITE MATERIALS

UDC 539.4:678.067:677

SCALE EFFECT OF FIBER STRENGTH AND PROPERTIES OF FIBER-BASED UNIDIRECTIONAL COMPOSITES

Riga MEKhanika Kompozitnykh Materialov in Russian No 2, Mar-Apr 84  
(manuscript received 19 Oct 83) pp 195-200

KORABEL'NIKOV, Yu. G., TAMUZH, V. P., SILUYANOV, O. F., BONDARENKO, V. M.  
and AZAROVA, M. T., All-Union Scientific Research and Planning Institute and  
Test Plant for Synthetic Fibers, Moscow; Institute of Polymer Mechanics,  
LaSSR Academy of Sciences, Riga

[Abstract] Reinforcing fibers are subject to a scale effect related to binding length. Previous studies have ignored the importance of fiber-matrix shift; the present study considers the effect of adhesion strength on composite material failure under stretching and offers a simplified theoretical model for determining applicable parameters. The hypothesis that strength increases with fiber separation in the composite is tested. The authors note that practice has shown that maximum theoretical strength is never reached because at low stress values, fiber breaks result in the development of major cracks. Various approaches to assessing the strength of fiber-reinforced composite materials are suggested, with emphasis on the Weibull distribution. The authors conclude that reducing fiber diameter and increasing adhesion are key factors for improving strength. A theoretical mathematical model is shown to coincide with experimental results. Figures 4; references 5: all Russian.  
[112-12131]

UDC 539.37:678.067

DEFORMATION OF FIBER-REINFORCED LAMINATED COMPOSITE NEAR FREE SURFACE

Riga MEKhanika Kompozitnykh Materialov in Russian No 2, Mar-Apr 84  
(manuscript received 22 Mar 83) pp 228-232

RASSOKHA, A. A., Khar'kov Aviation Institute imeni N. Ye. Zhukovskiy

[Abstract] Studies of fiber-reinforced composites to determine stress and deformation have usually focused on heterogeneous properties, while failing to consider the effect of lateral compression on the free surface and elsewhere. The present article reports on more comprehensive consideration of both heterogeneity and free-surface deformation properties. An orthogonal reinforced

regular parallelepiped with facets parallel to the reinforcing fibers was chosen as the test model. Effective elasticity moduli of inner and outer layers were found to be 4% less than those of inner laterally reinforced layers of the laminate. The theoretical results were verified by speckle-holographic interferometry, which showed that the stress in inter-fiber spaces ( $1.7 \pm 0.2$ ) corresponded satisfactorily to theoretical values. Fiber separation had a predictably major effect on stress concentration. Figures 3; references 6: all Russian.  
[112-12131]

UDC 624:678.067

#### DEFORMABILITY AND BEARING STRENGTH OF SHELLS MADE ON RELEASE MANDREL

Riga MEKHANIKA KOMPOZITNYKH MATERIALOV in Russian No 2, Mar-Apr 84  
(manuscript received 26 Apr 83) pp 279-282

PICHUGIN, V. S., PROTASOV, V. D. and STEPANYCHEV, Ye. I., Moscow Institute of Aviation Technology imeni K. E. Tsiolkovskiy

[Abstract] While winding continues to be the basic method for making shells of composite materials, it has fundamental shortcomings related to structural density and contact pressure. The present article reports on production of such shells on a release mandrel and test results of deformability and bearing strength of such shells. A key feature of this method is related to the dependence of physicomachanical properties of wound plastics on stretching of reinforcing elements. While theoretical studies showed that a "wet wrapping" procedure could provide significant improvements in these parameters, existing release mandrel devices were unsuitable, so a new type, which is diagrammed and described, was designed. The key technical parameter is summary axial force, which was controlled during thermal processing to affect residual stress in the final product. Results showed that increasing the axial force improved bearing strength by 10-12% and failure stress resistance by 16-20% in spiral and ring layers. Other parameters, including axial deformability and shell mass reduction, were also improved. Some increase in rigidity was also noted. Figures 3; references 4: all Russian.  
[112-12131]

MATERIALS SCIENCE INSTITUTE DEVELOPS COMPOSITE MATERIALS

Kiev RABOCHAYA GAZETA in Russian 13 Jul 84 p 2

NAUMENKO, I.

[Abstract] The lengthy article reports on development of composite materials at the Ukrainian Academy of Sciences' Institute of Materials-Science Problems. Fields in which these materials have found application are said to include aerospace technology, superdeep drilling and cryosurgery.

The institute's department of porous materials, which is headed by Doctor of Technical Sciences A. G. Kostornov, is developing composite materials with microscopic pores for filtration and other purposes. One such material is said to retain all of the structural properties of non-porous titanium alloys. The department headed by Doctor of Technical Sciences, Professor M. S. Koval'chenko reportedly has developed a ceramic internal-combustion engine.

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## FERROUS METALLURGY

### DEVELOPMENT OF FERROUS METALLURGY DESCRIBED

Moscow EKONOMICHESKAYA GAZETA in Russian No 24, Jun 84 p 2

[Article by I. P. Kazanets, USSR minister of ferrous metallurgy]

[Text] Comrade K. U. Chernenko called the upswing in our industry a gratifying fact for the entire economy in the speech he gave at a meeting with workers of the Moscow "Serp i Molot" [Hammer and Sickle] Metallurgical Plant.

The primary task of the USSR Ministry of Ferrous Metallurgy is to provide the national economy with metal products of the appropriate quality and variety on the basis of intensification, making significant increases in production efficiency, improving the structure of production, and providing fundamental technical re-equipment and replacement of fixed capital.

It is well known that the largest consumers of our products are tractor and agricultural machine building (including machine building for animal husbandry and fodder production), the automotive industry, and power, heavy, and transport machine building. The USSR Ministry of Ferrous Metallurgy, together with the Ministry of Tractor and Agricultural Machine Building, the Ministry of Machine Building for Animal Husbandry and Fodder Production, the Ministry of the Automotive Industry, and other ministries, adopted programs to develop, assimilate, and incorporate economical types of metal for agricultural equipment. These programs call for utilization of new materials and improvements in the quality of metal products to bring about an increase in the life of engines from 4000 to 8000-10,000 hours. Improving the durability of the frames should reduce the weight and increase the service life of agricultural machinery and tractors from 6000 to 10,000 hours.

To help carry out the Energy Program, ferrous metallurgy is organizing the production of new, highly durable well-drilling casings and pump-compressor pipes with progressive designs, made primarily of cold-resistant and rust-resistant materials; as well as a large-diameter pipe with external and internal insulation for gas transport; and pipes for the transport of oil and petroleum products.

To reduce the amount of metal used in machinery and construction projects, it is very important for our industry to be provided with products in accordance with orders and contractual obligations. Producing only that metal needed to fill orders is the surest guarantee of economy.

There has been some progress in this direction. In 1981, 7.2 percent of consumers' orders went unfulfilled; in 1982, 6 percent; and in 1983, only 2.1 percent of the orders for rolled metal were not filled.

Enterprises of the "Soyuzmetallurgprom" [All-Union Metallurgical Enterprises Industrial Production Association] and the UkSSR Ministry of Ferrous Metallurgy have improved their work to fill orders. Last year the Uzbek, Lysva, Guryev, Taganorog, and Konstantinovka metallurgical plants, the Metallurgical Plant imeni Komintern, and the Novomoskovsk Pipe Plant fulfilled their contractual obligations by 100 percent. The Nizhniy Tagil, Cherepovets, Makeyevka, and West Siberian combines fulfilled their delivery plans by over 99 percent.

Over the first 4 months of this year orders for finished rolled metal have been met by 99 percent, and orders for steel pipe have been met by 98.8 percent. Over 45 percent of all enterprises that supply finished rolled metal have completely fulfilled the plan for deliveries. Among these are the West Siberian, Novolipetsk, and Makeyevka metallurgical combines and the Kramatorsk, Verkh-Issetskiy, Tuganorog, Lysva, and other metallurgical plants.

At the same time, the industry has not managed to fill orders for non-rusting, special, bearing, and drill steel, for thin tinplate, pipes needed in the petroleum industry and for high-pressure boilers. The failure to fulfill orders has elicited justified reprimands aimed at metallurgists.

I should point out that every improvement in the level of fulfillment of orders and contracts in ferrous metallurgy is the result of great efforts. The industry produces a huge range of different sorts of steel (over 2800), special shaped sizes of rolled metal, pipes, and metal products. The size of the orders ranges from hundreds of thousands of tons to several kilograms. This kind of variety is natural, and the range of products will expand as the amount of metal used in the products decreases. Therefore, the USSR Ministry of Ferrous Metallurgy is directing all industrial production associations, combines, and plants to strive for complete fulfillment of delivery plans and contractual obligations.

A search is being conducted in ferrous metallurgy for an indicator that will provide the most objective reflection of the results of collectives' production activity.

It is well known that planning the output of products in ferrous metallurgy is expressed in physical terms. This is a result of the fact that the ton unit is used in all calculations to arrive at physical balances and it is the only indicator that allows balancing of production for all metallurgical processing. Moreover, the physical ton unit does not provide an incentive for enterprises to produce economical, but more labor-intensive goods.

This problem is especially critical for the production of rolled metal, the basic equipment of which has widely varying design and technical characteristics. Indicators of hourly productivity in manufacturing a variety of rolled metal at similar locations, even on the same kind of mills, differ in terms of absolute size. For example, at the Magnitogorsk combine the hourly

productivity of the "250" mill manufacturing circles 10 and 20 mm in diameter changes from 40 to 75 tons per hour. The higher the metal consumption of the product, the greater the productivity of the mill, if it is measured in tons.

Since 1 January 1984 all enterprises in the sector producing finished rolled stock were converted to planning its production in standard tons according to the reduced assortment taking into account the labor-intensiveness.

The plan for metal production in reduced and physical tons broken down into quarters is confirmed by the USSR Ministry of Ferrous Metallurgy and is given to enterprises, who report it to the Supply and Sale of Metal Production Main Administration so that reports on its load can be developed. The reports indicate production volumes both in reduced and physical tonnage. These confirmed reports form the basis for the direct workload of rolling mills and for assigning customers to suppliers; that is, a portfolio of orders for each individual mill is formulated.

The economic incentive system is also tied to the new indicator. Daily quotas for mills and shift brigades are assigned in physical and reduced tonnage. The new assignment system makes it possible to reduce the shortage of labor-intensive types of metal products, which often arises not as a result of a shortage of manpower and material resources that are needed for their production, but because a particular type of rolled stock is not profitable for the manufacturer.

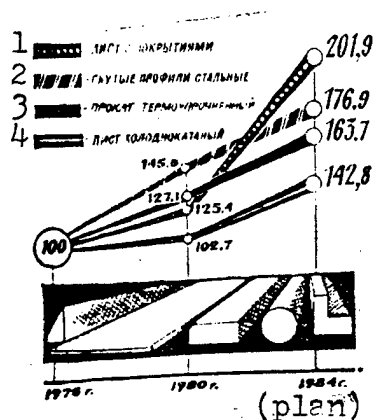
Last year, when the new indicator underwent experimental testing, the metal consumption of rolled stock dropped by 1 million tons. This is evidence of the large reserves that exist for increasing production efficiency and that can be put into use without any capital expenditures.

Metallurgists see improvement of the product assortment and of the quality of metal products as basic goals.

In less than three five-year plans, the assortment of products put out by enterprises of the USSR Ministry of Ferrous Metallurgy more than doubled. Today metal-consuming sectors receive from us over 7000 different shape sizes of finished rolled stock, as opposed to 3300 in 1970.

Today graded rolled stock accounts for the majority (57 percent) of the rolled metal consumed throughout the national economy. Recently the consumption of rolled sheet metal has been growing at a very rapid rate, particularly thin sheet metal, cold-rolled metal and hot-rolled building metal. This trend will continue in the future. As a result, the proportion of graded rolled stock will decline.

Since the beginning of this year, 17 enterprises have organized production of sheet and shaped rolled stock with differing durability characteristics, the use of which provides a 5-13 percent savings of metal among consumers. Deliveries of rolled metal of this type in the top durability group exceeded those for the same period last year by a factor of 1.7, and deliveries of metal in the second durability group were higher by a factor of 2.3.



Production of economical types of rolled metal (1975 = 100 percent)

1--sheet metal with coatings

2--bent, shaped steel

3--heat tempered

4--cold-rolled sheet metal

Improving the quality of and expanding the assortment of ferrous metals makes it possible to decrease their relative consumption in the national economy.

For example, the saving of metal in the national economy only as a result of delivering efficient types of products was 1.8 million tons in 1983, compared to the consumption in 1980; the saving for 1984 is planned at 3.5 million tons.

The USSR Ministry of Ferrous Metallurgy has set renewal of fixed production capital as a top-priority goal. In the sector, alongside contemporary metallurgical equipment, a large quantity of old machinery is in operation, whose depreciation period expired long ago. The depreciation norm for reproduction of fixed capital is no less than 4 percent, while over the past 15 years only 1 percent of the fixed capital has been withdrawn.

Utilization of obsolete equipment results in greater consumption of fuel, power, and material resources. If a blast furnace is being used, the consumption of coke per ton of cast iron is 200 kg higher than it would be with a contemporary furnace. In the production of rolled metal the consumption of metal per ton of output is 170-200 kg higher than when new continuous mills are used. Labor productivity at contemporary blast furnaces is 8 times higher, and at sheet mills 12 times higher, than with the old equipment.

Calculations show that the annual level of renewal of fixed production capital should be a minimum of 3 percent. Planning agencies should consider this process when working out long-range national economic plans.

Fundamental technical re-tooling of the industry is a top-priority goal. Increasing the intensity of national production inevitably brings with it a decline in the rate of quantitative growth in ferrous metallurgy production as a result of a number of progressive trends.

Taking into account the need for the most efficient processing of high-quality and economical types of metal products, in their plans consumers should call for accelerated rates of technical re-tooling of casting and forging plants and they should improve existing norms for designing and planning machinery and metal products.

Today, in accordance with the decision of the Politburo of the CPSU Central Committee on making technical improvements in ferrous metallurgy, we have started implementation of a program for the reconstruction, technical re-tooling, and renewal of fixed capital. There are plans to implement a substantial portion of this plan during the 12th Five-Year Plan.

Today metallurgists are working successfully on fulfilling the 1984 plan quotas and the socialist obligations for providing increases in labor productivity and an additional reduction in production costs, beyond what is called for in the plan. A good start has been made.

During the first four months of this year the sector has fulfilled its plan for producing the basic types of goods. An additional 260,000 ton of cast iron have been produced, along with 400,000 tons of steel, 300,000 tons of finished rolled stock, and 6000 tons of steel pipe. Socialist obligations are being met completely--the increase in labor productivity is 2.4 percent above what is called for in the plan, and production costs have been reduced by 0.6 percent beyond the plan goal.

Now it is especially important for us to reinforce this positive shift in our work, and to give it a permanent nature. After all, there are still some enterprises that are lagging behind, right alongside the leading enterprises. Our most immediate goal is to bring them up to the level of the best. Metallurgists will fulfill this party assignment with honor.

9967

CSO: 1842/109

## FORMING

### COLD EXTRUSION OF PRECISION BEARING STOCK

Moscow MOSKOVSKAYA PRAVDA in Russian 6 Jul 84 p 1

[Article by S. Nikolayev]

[Excerpt] Specialists of the Moscow Institute of Machine Tools and Tools have turned over a newly developed process to industry.

Specialists of the institute's chair of forging and stamping equipment and technology proposed a method for the cold extrusion of precision stock for bearing races and rollers. It should be noted that the processes developed by the scientists can also be used in the manufacture of a number of other parts.

One of the main advantages of the proposed process is the low amount of waste. Tests have shown that the cold extrusion of precision stock permits a considerable reduction of traditional tolerances, with resulting savings of 20 or even 30 percent of metal.

The developers also made sure that the introduction of the proposed processes would not necessitate the design and manufacture of new sets of production equipment. The advanced processes can be carried out on existing multistep automatic presses and present-day automation lines.

The newly developed process, which is protected by a certificate of invention, was developed by the institute in close association with industrial specialists. Introduction of the advanced processes at shops of the "GPZ-1" (state bearing plant) Production Association and other enterprises is planned for as early as the end of 1985.

FTD/SNAP  
CSO: 1842/119

## INSTRUMENTATION AND EQUIPMENT

### ROLLED-METAL CUTTING MACHINE DEVELOPED AT AVIATION ENTERPRISE

Ashkhabad TURKMENSKAYA ISKRA in Russian 5 Jun 84 p 4

[Article by A. Alov]

[Text] G. M. Kulihev and V. Ye. Yershov, efficiency promoters of the Ashkhabad Aviation Enterprise, have developed an economical and highly productive machine for cutting rolled metal. Metal is now cut into pieces not with oxyacetylene torches or hacksaws, but with a pneumatic abrasive tool. Rolled metal sections up to 6 centimeters thick can be cut on this comparatively simple machine.

As a result of the introduction of this innovation, manual labor has been eliminated in arduous operations, labor productivity has been heightened by 12 percent, and more than 2,000 kilowatt-hours of electric power a year is being saved.

FTD/SNAP

CSO: 1842/119

AUTOMATED CASTING EQUIPMENT FOR ENGINE PLANTS, AUTOMOTIVE INDUSTRY

Kishinev SOVETSKAYA MOLDAVIYA in Russian 9 Jun 84 p 2

A. Bol'shakov, director of the Foundry Machinery Plant imeni Kirov (Tiraspol')

[Abstract] The author discusses the development and production of economical new types of automation equipment at his plant. This plant is said to be the country's only producer of automatic lines for chill, centrifugal and investment-pattern casting and casting in shell molds.

The plant's products are said to include robots with control devices, which perform such functions as pouring metal, removing finished products and lubricating machinery. About 850-900 such robots are being shipped each year to foundries. Other equipment produced by the plant is intended for the production of castings which require minimal finishing work. Cited as examples are a highly mechanized aluminum-casting shop at the Altay Engine Plant and a facility for the production of precision steel and nonferrous castings at the Kama Automotive Plant. The foundry machinery plant manufactured all of the equipment of the engine plant's shop, which has set a standard for the creation of similar shops in various branches of industry, according to the author. The automotive plant's facility is called the first completely automated unit of its kind in the country. Three sets of equipment for automatic production lines equipped with manipulators were produced for this facility. It has made possible annual savings of 3,000-3,500 tons of metal and the freeing of 450 metal-cutting machine tools.

FTD/SNAP

CSO: 1842/119



POWDER METALLURGY

UDC 669.295:621.984:621.762.04

MECHANICAL PROPERTIES OF COMPONENTS MADE FROM POWDERS RECEIVED BY PROCESSING  
LOW-GRADE POROUS TITANIUM

Moscow TSVETNYYE METALLY in Russian No 5, May 84 pp 92-93

PAVLOV, V. A., KOKORKIN, S. N., VOLCHOK, Zh. G., DROZDENKO, V. A.,  
AVRUNINA, G. V. and PROZOROV, V. M.

[Abstract] Titanium powders produced from screening better-quality ore were studied to determine mechanical qualities of components made up of powders with dimensions of  $-1.0+0.63$ ,  $-1.0+0.18$  and  $-.63+0.10$  mm. The powders were sintered at  $1000^{\circ}$  and  $1200^{\circ}\text{C}$  in vacuum ovens, then hot-stamped after heating at  $950-975^{\circ}\text{C}$  in an argon medium. Results indicated that the products were equal in durability to stamped titanium products, but due to impurities, their plastic properties were much lower. Vacuum sintering relieved internal stresses and redistributed impurities, thus reducing instability, but no appreciable improvement in plastic properties resulted. Components requiring durability without tensile strength can be made of this type of powdered titanium.

[114-12131]

PRODUCTION OF EXTRA-PURE IRON FOR CERMET BEARINGS

Kiev RABOCHAYA GAZETA in Russian 3 Jul 84 p 1

A. Kovtun, correspondent (Brovary, Kiyev Oblast)

[Abstract] The article reports on a new process for producing iron powder that is almost chemically pure. The process was demonstrated for the author of the article by workers of the Brovary Powder Metallurgy Plant, where the process has been introduced. The iron powder obtained from the process is used in the production of cermet bearings. These bearings have pores which are filled with an oil lubricant. Parts employing the bearings can operate for years without additional lubrication, it is claimed.

FTD/ SNAP

CSO: 1842/119

## POWDER METALLURGY R & D ORGANIZATIONS FEATURED

Moscow SOVETSKAYA ROSSIYA in Russian 7 Jul 84 p 2

V. Dolmatov, correspondent

[Abstract] The article opens a series that is to be run in the newspaper on powder metallurgy technology. The author visited a number of research organizations and industrial facilities that are developing and introducing this technology.

The powder metallurgy laboratory of the Perm' Polytechnical Institute is said to be one of the strongest in the Russian republic. Headed by Doctor of Technical Sciences Vladimir Nikitovich Antsiferov, a USSR State Prize laureate, it has an experimental production facility with the latest equipment, and a test facility for explosion forming of products. This permits developments to be carried through to industrial technologies. The laboratory's staff of 200 includes 20 candidates of sciences. Beneficiaries of the laboratory's developments are said to include tractor and airplane builders. The economic effect from its developments is said to have totaled 15 million rubles in the last three years, and the returns provide for most of the laboratory's 2.5 million ruble budget.

The author also visited Tomsk University's Scientific Research Institute of Applied Mathematics and Mechanics. Its director, A. D. Kolmakov, said that the institute's researchers are always looking at potential applications of their basic research. He mentioned the following heads of organizations as also being 'enthusiasts' of the introduction of powder metallurgy: V. Ye. Panin, director of the Academy of Sciences' Institute of the Physics of Strength and Materials Science in Tomsk; S. S. Kiparisov, president of the Moscow Institute of Fine Chemical Engineering; and B. S. Mitin, president of the Moscow Aviation Technology Institute.

The author also visited a textile factory and learned how a serious production problem had been eliminated with a powder metallurgy technique for reconditioning worn machinery parts. Other examples of how industrial facilities are benefiting from powder metallurgy are mentioned. In closing, however, the author observes that although Soviet theoretical developments in powder metallurgy are generally recognized as being appreciably ahead in world competition, the USSR is lagging noticeably behind in technological applications.

FTD/SNAP  
CSO: 1842/119

RARE METALS

YE. M. SAVITSKIY OBITUARY

Moscow MOSKOVSKAYA PRAVDA in Russian 30 Jun 84 p 4

[Text] Yevgeniy Mikhaylovich Savitskiy, corresponding member of the USSR Academy of Sciences and a prominent scientist in the field of rare metals, has died at the age of 72. A member of the Communist Party of the Soviet Union since 1930, he was a laureate of State Prizes.

The death announcement is made with deep regret by the presidium of the USSR Academy of Sciences, the Department of Physical Chemistry and Technology of Inorganic Materials, the USSR State Committee for Science and Technology, the Ministry of Nonferrous Metallurgy, the Ministry of the Electronics Industry, the Ministry of the Chemical Industry, the Oktyabr'skiy Rayon Committee of the Communist Party, and the USSR Academy of Sciences' Institute of Metallurgy imeni Baykov and Institute of General and Inorganic Chemistry imeni Kurnakov.

FTD/SNAP

CSO: 1842/119

## SUPERALLOYS

UDC 669:539.43

### EFFECT OF STRESS CONCENTRATION ON FATIGUE RESISTANCE OF HEAT-RESISTANT NICKEL ALLOYS

Kiev PROBLEMY PROCHNOSTI in Russian No 5, May 84  
(manuscript received 21 Oct 82) pp 10-14

BELYAYEV, M. S. and ZHUKOV, N. D., Moscow

[Abstract] Sensitivity to stress concentrations is an important feature of durability. The present article reports on study of three types of stress concentrations for varying loads on heat-resistant nickel alloys, taking into account structure, production technology, temperature and base of testing and the magnitude of the theoretical coefficient of stress concentration. Tests were made using straight circular bending and compression-stretch at 50 Hz at room and elevated temperatures. Stamped and two types of cast nickel alloy components were tested. Results showed that at room temperature, the basic mechanism for tempering nickel alloys was essentially ineffective. Crystallized alloys had the same phase components and defects as other forms, but were more sensitive to stress concentrations due to microplastic deformation features at room temperature. At higher temperatures the theoretical coefficient of stress concentration increased in a monotonic manner. The fatigue curve under the test conditions showed a sudden shift in straight circular bending at about  $10^8$  cycles; a more regular curve was found with compression-stretch tests. Figures 3; references 8: 6 Russian, 2 Western.  
[115-12131]

UDC 620.172.251

### KINETIC TIME-TEMPERATURE EQUATION FOR CREEP OF HEAT-RESISTANT ALLOYS TAKING AGING INTO ACCOUNT

Kiev PROBLEMY PROCHNOSTI in Russian No 5, May 84  
(manuscript received 15 May 83) pp 7-10

KISELEVSKIY, V. N., Institute of Problems of Strength, UkSSR Academy of Sciences, Kiev

[Abstract] Kinetic principles of creep in heat-resistant steels and alloys have helped to give relatively precise estimates of deformation all the way to failure, but the accuracy of calculated values for the first phase of creep has been poor, notably in alloys with high nickel and molybdenum content. This

divergence has been attributed to heat effects on redistribution of deformation from granular boundaries to the matrix. The present article shows the author's theoretical calculations of this process for OKh16N15M3B steel and alloys of the Kh20N45M4 type. The shortcomings of the approach used are chiefly of a practical nature, so that further calculation and experimental verification were performed to show that creep deformation depends on activation energy of destructive processes, as well as on activation energy variations and plastic flow. Since, however, the formulas developed are based on energy variations and not absolute values, their application is limited.

Figures 1; references 6: all Russian.

[115-12131]

## TITANIUM

### AUTOMATED TITANIUM TETRACHLORIDE DISPENSER SYSTEM

Kiev PRAVDA UKRAINY in Russian 4 Jul 84 p 2

[Article by A. Rekubratskiy]

[Text] Titanium production depends on the accuracy of dispensing the starting material--titanium tetrachloride, a corrosive liquid with specific characteristics. Until recently, at the Zaporozh'ye Titanium and Magnesium Complex this operation was controlled by the furnace operators, but even the most experienced workers could not ensure ideal conditions.

To the rescue came scientists of the Zaporozh'ye affiliate of the All-Union Scientific Research Institute "Tsvetmetavtomatika" (automation of nonferrous-metal industry), who have developed a dispenser of heightened accuracy for corrosive liquids, as well as a system of automated grouped dispensing. Each such system now serves 25 furnaces. Its introduction at the complex has resulted in savings of about 300,000 rubles.

FTD/SNAP

CSO: 1842/119

UDC 669.295:669-176:539.32.001

ELASTIC PROPERTIES OF TEXTURED SHEETS OF TWO-PHASE TITANIUM ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 57, No 4, Apr 84  
(manuscript received 22 Jun 83) pp 818-821

ZAKHARCHENKO, I. G., IVANIY, V. S., IVANIY, N. V. and KSHNYAKIN, V. S.,  
Sumy Pedagogic Institute imeni A. S. Makarenko

[Abstract] Voigt, Reuss, and Hill averaging are used to calculate the elastic properties of sheets of two-phase titanium alloys considering the texture state of each phase in the alloy. Texture classification is based on the theory of symmetry, according to which each texture can be considered quasisingle crystals described by the corresponding symmetry group. Rolling textures of both  $\alpha$  and  $\beta$  phase polycrystalline alloys were considered quasisingle crystals of orthorhombic symmetry. The elastic properties of the texture of each phase are unambiguously determined by a fourth rank tensor containing 9 constants. Texture elasticity moduli were calculated for sheets of industrial two-phase  $\alpha+\beta$  titanium alloys VT14 and VT23 as delivered. Analysis of the data indicate that VT14 in which the  $\beta$  phase content is not over 10-12% has an angular variation of Young's modulus similar to that observed in single-phase  $\alpha$  alloys with the same rolling texture type. Increasing the  $\beta$ -phase content to 30-35% causes this variation to change significantly, approaching the angular variation of Young's modulus observed in  $\beta$  titanium. References 16: 9 Russian, 7 Western. [105-6508]

UDC 669.295:537

TEXTURE EFFECT ON ANISOTROPY OF ELECTRIC AND MAGNETIC PROPERTIES OF TITANIUM ALPHA-ALLOYS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 84  
(manuscript received 2 Apr 82) pp 122-125

REYMER, N. D., ADAMESCU, R. A. and MUKHAYEV, V. V., Sverdlovsk

[Abstract] Magnetic and electric properties of polycrystalline alpha-alloys of titanium with hexagonal, dense structures tend toward anisotropy. The present article reports on study of magnetic susceptibility and mean electrical resistance of VT5-1 and OT4-1 alloys after cold rolling at compression ranging

from 20 to 70% for the former, and 30 to 80% for the latter alloy. Subsequent X-ray studies of the crystalline structure confirmed its role in determining the nature of anisotropy of susceptibility in relation to the degree of compression. Differences in these parameters for the two alloys showed that manganese has more influence on magnetic susceptibility than tin in titanium alloys. Figures 1; references 9: 7 Russian, 2 Western.  
[119-12131]

UDC 669.295:620.187.3

ELECTRON MICROSCOPE STUDY OF PROCESSES OF POLYGONIZATION AND  
RECRYSTALLIZATION IN  $\alpha$ -PHASE OF TWO-PHASE ( $\alpha+\beta$ )-TITANIUM ALLOYS WITH PLATE  
STRUCTURE

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 57, No 4, Apr 84  
(manuscript received 28 Jun 83) pp 737-743

PERTSOVSKIY, N. Z., SEMENOVA, N. M., BRUN, M. Ya. and MOZOLEVSKAYA, O. A.

[Abstract] A study is presented of processes of polygonization and recrystallization in the  $\alpha$ -phase, responsible for the formation of the globular structure, in two-phase titanium alloys during deformation and subsequent heat treatment in the ( $\alpha+\beta$ ) area, necessary to seek paths facilitating globularization of the  $\alpha$  phase in semifinished goods with the initial  $\beta$  transformed structure. Experiments are performed on a typical two-phase ( $\alpha+\beta$ ) titanium alloy, type VT3-1. The results obtained show that heterogeneity of the structure of semifinished goods after hot deformation and subsequent annealing results basically from differences in the flow of recrystallization in the  $\alpha$  phase, which in turn results from heterogeneity of the effect of deformation on the  $\alpha$  plates which have different orientation within the limits of a single initial  $\beta$  grain. The structural heterogeneity influences the level of the mechanical properties. In ( $\alpha+\beta$ ) titanium alloys with  $\beta$  transformed structure there are two recrystallization mechanisms: a) formation and growth of new  $\alpha$  grains within the initial  $\alpha$  plates; and b) separation of  $\alpha$  plates into globules as disorientation between subgrains exceeds 10 to 15°. Unidirectional deformation of two-phase alloys with heating to the ( $\alpha+\beta$ ) area does not assure homogeneous occurrence of recrystallization in the  $\alpha$  phase. Figures 7; references 5: 4 Russian, 1 Western.  
[105-6508]



PLASTICITY OF LARGE-GRAIN TITANIUM ALLOY TYPE VT30 IN THE  $\beta$  AREA

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYE in Russian Vol 57, No 4, Apr 84  
(manuscript received 14 Feb 83) pp 788-794

KAYBYSHEV, O. A., GALEYEV, R. M. and SALISHCHEV, G. A., Ufa Institute of  
Aviation imeni S. Ordzhonikidze

[Abstract] Results are presented from a systematic study of the structure and mechanical properties of VT30 alloy during hot deformation. The alloy was studied in two states: initial hot rolled and annealed at 1000°C. The mechanical properties were determined in extension at  $3.3 \cdot 10^{-5}$ – $3.3 \cdot 10^{-2}$  s<sup>-1</sup>. Deformation relief was studied on a polished surface of the specimens. Microstructure of the deformed specimens was studied by optical metallography and electron microscopy. It was found that VT30 with large grain microstructure shows signs of superplasticity upon deformation in the  $\beta$  area. Conditions of superplasticity correspond to formation and constant reproduction of subgrain structure in the process of deformation. Grain boundary slipping occurs along the boundaries of the initial grains and the subgrains formed during deformation, which makes a definite contribution to total deformation. Figures 4; references 7: 6 Russian, 1 Western.  
[105-6508]

## LOW-CYCLE FATIGUE OF VT1-0 ALLOY AND CHANGES IN ITS FINE STRUCTURE AT TEMPERATURES OF 293–4.2°K

Kiev PROBLEMY PROCHNOSTI in Russian No 5, May 84 (manuscript received 26 Jan 83)  
pp 14-18

STRIZHALO, V. A., PETROV, Yu. N., NADEZH DIN, G. N., ZINCHENKO, A. I.,  
SVECHNIKOV, V. L. and BAKALINSKAYA, N. D., Institute of Problems of Durability,  
UkrSSR Academy of Sciences, Kiev

[Abstract] Although general principles for increasing durability and reducing plasticity of materials at low temperatures have been determined, the physical nature of stress-deformation instability at temperatures near that of liquid helium has not been studied thoroughly. The present article reports on study of low-cycle fatigue of the alpha-titanium alloy VT1-0 during cooling to 4.2°K and structural aspects of its deformation and failure. The test specimens, 2 mm in thickness, were subjected to a pulsating load at 2 cycle/min, at 293°K in air and 77 and 4.2°K in liquid nitrogen and helium. The intermittent viscosity observed in atmospheric and liquid nitrogen media was explained by adiabatic deformation under conditions of reduced heat absorption and transmission. Cyclic creep in the liquid helium, collapse of cellular structure and formation of doublets in alpha-titanium at 4.2°K confirmed the function of these factors in the intermittent viscosity of VT1-0 alloy at the temperature of liquid helium. Dynamic deformation hardening and increased twinning are the key determinants of fatigue. Figures 5; references 10: 8 Russian, 2 Western.  
[115-12131]

## DEFORMATION AND FAILURE OF TITANIUM ALUMINIDE

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 84  
(manuscript received 31 Jan 83) pp 164-168

BARINOV, S. M. and SAMOYLENKO, Z. A., Moscow, Donetsk

[Abstract] The intermetallic compound TiAl has great heat resistance and hardness, but brittleness below 700°C limits its applications. The authors analyzed that brittleness by studying temperature correlation with mechanical properties and inter-atomic interactions in a stoichiometric alloy with 36% aluminum. Mechanical properties were measured in a temperature of 20-1300°C by concentrated bending of smooth and cracked samples. Microhardness, X-ray and fractographic studies were also made. An ion-covalent component discovered in the test TiAl alloy was attributed to the boron alloying agent. The latter increased the covalent component, probably at the expense of the boride phase, and also increased the metallic component. Methodological shortcomings prevented precise measurement of  $TiB_2$ . The refining effect of boron was similar to its effect in molybdenum, while segregation defects in the process before emission of boride and metallization of the covalent component are probably related to the properties found in the titanium aluminide alloy. Granular pulverization also contributes to its low-temperature brittleness. Figures 3; references 18: 13 Russian, 5 Western.  
[119-12131]

## EFFECT OF THERMOCYCLIC PROCESSING ON PHASE COMPOSITION AND STRUCTURE OF VT22 ALLOY

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 84  
(manuscript received 16 Dec 82) pp 136-141

GRIDNEV, V. N., IVASISHIN, O. M. and SVECHNIKOV, V. L., Kiev

[Abstract] Thermocyclic processing of titanium alloys has been used to enhance recrystallization in subsequent annealing, but knowledge of precise phase and structural changes involved is limited. The present article reports on thermocyclic processing of highly alloyed VT22 at temperatures from room temperature to 750°C, with 15-minute retention at the highest temperature of any series followed by air cooling. The heating rate was 2.5°C/sec. The alloy's original alternating alpha- and beta-phase, the latter in particular with relatively low defectiveness, changed after one cycle as the transformation  $\alpha+\beta \rightarrow \beta$  at temperatures of 750°C took place and was fixed during cooling. A second type of structure underwent dissolution of disperse alpha-phase particles, while platelets of the primary alpha-phase decreased slightly in size. The principal change from initial structure to that after one cycle was the absence of the face-centered cubic lattice phase in the processed

alloy. This change was taken as indirect evidence that formation of the face-centered cubic lattice phase is not always an intermediate stage in alpha  $\rightarrow$  beta conversions. Another important feature is the increase in numbers of micro-doublets of the alpha-phase. Interphase stress relaxation in the beta-phase was almost totally absent, indicating increased durability and suggesting that thermocyclic processing is ineffective for use with alloys that already contain high beta-phase amounts. On the other hand, its use can be very effective in increasing durability of predominantly alpha-phase VT22 alloy. Figures 3; references 18; 11 Russian, 7 Western.  
[119-12131]

## WELDING

UDC 669.24/29:669.09.28

### BONDING MATERIALS BY GAS-PHASE PRECIPITATION

Moscow TSVETNYYE METALLY in Russian No 5, May 84 pp 88-91

SOKOLOV, V. K., KOROLEV, Yu. M., FROLOV, V. V., STOLYAROV, V. I. and SOLOV'YEV, V. F.

[Abstract] While growingly sophisticated applications require permanently bonded materials, traditional welding methods do not always provide the required strength, particularly with porous materials, foils, wires and other small-gauge metals. The present study reports on tests of gas-phase precipitation for obtaining such bonds. Tests were conducted at below melting temperatures for all materials and did not involve recrystallization. Necessary conditions for success in such bonding were sufficient durability of the precipitate, presence of bond durability conditions for both precipitate and base material, and absence of reactions between the materials and the gas-phase medium used. The processes involved are hydrogen reduction of volatile halides such as fluorides and chlorides, thermal decomposition of volatile iodides, bromides and chlorides, and thermal dissociation of volatile carbonyls and organic metal compounds. Particular success was achieved with tungsten-hexafluoride precipitates. Angle, butt and lap joints were all produced successfully, but with thicker specimens some edge preparation was necessary. With notching the stretch durability of joints ranged from 160 to 250 MPa, and impact strength at the seam was 200-300 MPa. The gas-phase precipitation bonding process is recommended for thin-walled large-gauge components and for tungsten bonds with various metallic and ceramic materials. Figures 2; references 12: 6 Russian, 6 Western.  
[114-12131]

UDC 621.791.72.01:621.373.826

### CERTAIN FEATURES OF LASER WELDING WITH PENETRATING MELTING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 84 pp 14-16

SKRIPCHENKO, A. I., engineer, SURKOV, A. V., candidate of technical sciences and BASHENKO, V. V., doctor of technical sciences

[Abstract] Penetrating melting during laser welding can reduce the number of defects and the need for removing lining after welding, but energy requirements had not previously been determined. The present article reports on study

of welding processes and forms of penetrating melting in relation to radiation intensity penetrating the components being welded. The equipment used is diagrammed and described. Rate of welding was varied in the range of 4-20 mm/sec, with constant power in the focal point. Results showed that while the width of the bead on the surface closest to the laser varied little as component thickness and laser intensity increased, the bead on the opposite side showed significant variations. Thickness was also related to the formation of the weld "puddle" and heat conductivity. The basic mechanism of surface bead formation was found to be the heating of metal by the plasma source. The diameter of this upper channel was greater than that of the laser beam with penetrating melting. The radiation intensity passing through the metal was equal to the square of the thickness of the component being welded. Figures 7; references 6: 4 Russian, 2 Western.  
[113-12131]

UDC 621.791.72:621.373.826

#### NARROW-SEAM LASER WELDING OF COMPONENTS OF LOW THICKNESS

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 84 pp 13-14

LEVIN, G. I., engineer

[Abstract] Experience has shown that as the depth of laser welding increases relative to seam width, defects become an increasingly serious problem. Two approaches to phase interactions in such seams are examined in the present article: the search for stable conditions with both liquid and gaseous phases present in the crater, and attempts to eliminate one of the interacting components, the liquid phase, up to a given critical level. Factors of the options indicate the latter to be simpler in analytic terms, although it requires prevention of crater collapse and metal loss in liquid drop form. The chief geometric factor was determined to be the beam diameter in the focal plane, which reaches  $10^{-1}$  to  $10^{-2}$  mm for  $\text{CO}_2$  lasers. The high-frequency impulse radiation of the procedure used was regarded to be a quasi-constant-beam procedure. The process was determined to be sensitive to power intensity and wave-length variations. The impulse  $\text{CO}_2$  laser used was judged to be the only laser suitable for this type of narrow-seam welding. Figures 1; references 4: 3 Russian, 1 Western.  
[113-12131]

## FUSING CAPACITY OF CONCENTRATED LASER BEAM

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 84 pp 11-13

SPRIPCHENKO, A. I., engineer and SURKOV, A. V., candidate of technical sciences, Scientific Production Association "Central Scientific Research Institute for Machine-Building Technology"

[Abstract] Since the fusing capacity of a laser beam is far less than that of an electron beam used in welding and energy losses are related to ray deflection by metals and the plasma torch, the authors studied the influence of axial irregularities of power intensity after describing the process of laser welding in a mathematical model. The model discounts absorption and refraction of the laser beam in the plasma torch and assumes that the radiation falling on the surface is completely absorbed by it and the depth of the gas vapor channel is significantly greater than its diameter. Comparison of the calculated and experimental data obtained agree, and they show that the optimum focal length for the least energy losses in laser welding is  $(0.5--0.7)h$ , the latter being the optimum depth of focus for melting. Fusing capacity was found to increase with improved laser beam brilliance and to decrease as required depth increased. Figures 4; references 12: 7 Russian, 5 Western.  
[113-12131]

UDC 621.791.72:621.373.826

## INCREASING FUSION EFFICIENCY IN LASER WELDING WITH DYNAMIC BEAM FOCUSING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 84 pp 9-11

IVANOV, V. V., candidate of technical sciences, BAYKOV, V. V., engineer, GRIGOR'YANTS, A. G., doctor of technical sciences and SHIGANOV, I. N., candidate of technical sciences

[Abstract] A major shortcoming of laser welding in contrast to electron beam techniques is its relatively low heat efficiency. The present article reports on attempts to increase that efficiency by dynamic beam focusing with an opticommechanical scanner. Comparison of data for fixed and dynamic focusing indicates that the depth of fusion melting can be increased by as much as 45%, with little dependence on the rate of welding. Study of longitudinal macrofilings showed that variations in melting depth were also minimized. Efficiency was increased by 69-87%, depending on the alloy tested: The PT-3V titanium alloy, with relatively low heat conductivity, showed lesser increases in welding efficiency than did the AMg6 aluminum alloy with its significantly higher heat conductivity. Figures 4; references 4: all Russian.  
[113-12131]

## CERTAIN METALLURGICAL PROPERTIES OF LASER WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 84 pp 8-9

SURKOV, A. V., candidate of technical sciences, KOVALEV, V. V., engineer and NOVOZHILOV, N. M., doctor of technical sciences

[Abstract] To study the seam metal as a determinant of the mechanical properties of a seam, the authors investigated the transfer of hydrogen, silicon, manganese and titanium from the original metal and nitrogen and oxygen from the gaseous phase into the metal of perlite and austenite seams produced by laser welding, in comparison with other welding techniques. Experiments were conducted on 10GN2MFA, 22K and 08Kh18N10T steels with a constant beam CO<sub>2</sub> laser at a welding rate of 25 m/hr and beam angle of 73°. The content of alloying materials in the metal was determined by X-ray-fluorescent analysis, and the gas content by vacuum fusion. Results showed that losses of alloying elements are greater in laser welding than in arc and electron-beam techniques. Nitrogen transfer to seam metal in laser welding is also less by 2-3 times than in arc welding with protective gases, so that nitrogen can be used as a protective gas in CO<sub>2</sub> laser welding processes. Figures 1; references 5: 4 Russian. 1 Western.  
[113-12131]

## EFFECT OF SURFACE CONDITION AND EDGE PREPARATION ON METAL FUSION DURING LASER WELDING

Moscow SVAROCHNOYE PROIZVODSTVO in Russian No 5, May 84 pp 16-18

BASHENKO, V. V., doctor of technical sciences, KULIKOV, N. V., engineer and SURKOV, A. V., candidate of technical sciences

[Abstract] The effectiveness of laser radiation on metal during welding depends on surface condition, protective gas used, angle of laser contact and other factors. The present article reports on the effects of various coatings and edge preparation procedures on melting effectiveness and seam formation. Absorption of protective gas was measured on the basis of the plasma flow's presence above the metal surface and the use of helium to prevent formation of a screening layer of ionized gas vapor. In the tests, 08Kh18N10T steel was coated with KNO<sub>3</sub>, NH<sub>4</sub>F·HF, CaF<sub>2</sub>, CaCO<sub>3</sub>, Na<sub>2</sub>O+SiO<sub>2</sub> or FeCl<sub>3</sub> and FS-71 flux in thin coats that minimized pore formation. X-ray analysis showed that the best seam quality was achieved with KNO<sub>3</sub> and CaF<sub>2</sub> coatings and the FS-71 flux. Optic interruption in protective gas was found to absorb 45-60% of the laser beam's energy, but various additives increased the effectiveness of the laser, and seam preparation enhanced seam formation and the depth of fusion. Angle of contact was another important factor for effectiveness of laser welding. Figures 4; references 3: 2 Russian, 1 Western.  
[113-12131]

## MISCELLANEOUS

### NEW VAPOR-PHASE TECHNOLOGY DISCUSSED

Moscow IZVESTIYA in Russian 26 May 84 p 2

[Article by E. Manucharova, Special Correspondent to Izvestiya: "Refuting Axioms"]

[Text] "It's not possible. It will not be: it contradicts physical concepts," assert some.

It then follows, invariably: "That's the nature of scientific and technical progress, success will be ours" insist others.

The conflict proceeding technical revolutions often comes down to such antagonistic (though justified!) positions. The cost of success here is high: the overwhelming burdens on inventors, stress, searches, disappointments. And, finally, the primary discoveries: defining previously unknown principles which make it possible to transform yesterday's impossibility into today's reality. New branches of knowledge and new fields of the national economy are then born.

One of the most important and most recent such fields is special-purpose electrometallurgy. Its home is in Kiev at the Ye. O. Paton Institute of Electric Welding. This field generated structural materials without which even today original creations would be impossible. Their properties (according to old concepts) are anomalous and were achieved by nontraditional methods.

Boris Alekseyevich Movchan, Lenin Prize Laureate, Academician of the Academy of Sciences of the Ukrainian SSR and head of one of the largest divisions of the Paton Institute spoke on this fundamentally new, so-called vapor-phase technology in special-purpose electrometallurgy at a recent session of the Presidium of the Academy of Sciences USSR.

It was here that pioneering research was done which demonstrated the possibility of electron beam operation in a vacuum; superpure metals and alloys were obtained by electron beam welding. The materials processing research about which B.A. Movchan spoke required great scientific boldness.

In order to get an idea of this, it is necessary to remember the capabilities and laws of nature which defined the limits on improving metals. One of the most important properties of metals is plasticity, or as the great Lomonosov called it, "workability." Additionally, people very often require one



additional quality of a metal: hardness. However, the materials technology axiom states that if a metal is to be hardened by incorporating nonmetallic particles in it, the plasticity will then decrease in inverse proportion to the hardness of the metal. How can this be avoided? Can it?

No, it cannot, if old methods are used.

Yes, it can, if the material is rebuilt from free atoms and molecules. High-intensity beams of the "structural material" are obtained by evaporating various substances--metals and nonmetals--such as ceramics, in a vacuum. Electron guns are used for this. The new technology was developed in Academician B. A. Movchan's department.

When the substances are in their vapor phase the constraint on their reciprocal solubility is eliminated. Particles of matter which are normally incompatible (while they were in a liquid or solid phase) are now mixed in any desired ratio. The "vapor substances" are then deposited: condensed using the specified cooling technology onto special surfaces.

This is now materials with new structures and, hence, new properties which were chosen by their inventors, were developed. Here, the strength is increased in proportion with the plasticity. The physical nature of this phenomenon is investigated. This made it possible for scientists to create structural materials for practical applications based on such brittle metals as chrome. At room temperature chrome may be folded in half, just like a piece of paper.

Materials were also made to resist loads at high temperatures. Here again the scientists had to run counter to the metal-working technology axiom which states that in order to improve the heat resistance of a single metal it is necessary to combine it with more refractory metals. The new vapor-phase method makes it possible to obtain a heat-resistant material based on an entirely different principle. It is composed of thin alternating layers, like plywood. The heat resistance of pure iron is hundreds of times lower at sixty degrees than is a material consisting of microlayers of iron and refractory copper.

And, finally, the real capacity for self-controlled reliability is attained. In dispersion-hardened materials, an emerging brittle crack disappears: it "heals." The progress of the crack is halted by encountering a disperse particle.

The scientific council devoted to the problem of "New processes of manufacturing and treating metallic materials" of the Presidium of the Academy of Sciences USSR, which is headed by Academician B. Ye. Paton, is coordinating all research in this field as well as its industrial incorporation.

The first practical research by B. A. Movchan's department began with the vacuum deposition of protective coatings onto vital machine components. This included the blades of gas turbine engines. This process increased their operational life by a factor of 3 to 5, and yielded significant savings: nearly one million rubles per power-generating turbine at a gas pumping station.

"The type of protective coating is selected based on the operational conditions of the turbine and a number of other factors. The component ratios are also selected on this basis; they must be mixed in the gaseous phase and deposited as coatings" reports B. A. Movchan, "and this is what's important: the long-term heat resistance and the corrosion resistance of the condensed coatings are largely explained by the fact that their chemical composition is not at all independent of the composition of the protected alloys."

The speaker shows slides where the structures of the new materials are clearly evident, as well as graphs of the dependencies of anomalous properties on the structure and temperature as well as the loads. He also brought samples of the new materials and design components.

Electron-beam equipment built using the Paton Institute technology has found application in many industries. The new sets are sufficiently powerful: they produce up to fifteen kilograms of vapor an hour and produce finished blanks of up to one hundred kilograms. The evaporation and synthesis process is computer-controlled.

Slightly different equipment sets which were built using the principles of vapor-phase technology are operating beyond our planet. On the "Salyut-6" space station cosmonauts are running tests on a new on-board device, an "Evaporator", while aboard the "Salyut-7" station experiments with the new "M-Evaporator" have begun.

The Paton Institute's new research will expand and supplement the arsenal of existing means for manufacturing and treating materials (such as powder metallurgy and plasma technology). They have more than just practical significance. This is a new tool in research on the nature of matter which has enriched solid state physics and materials technology.

There is one more very important aspect. The research by the Ukrainian scientists has made it possible to develop a new creative realm so that the harmony of the first realm, on which each of our lives depends, will not be harmed. Vapor/phase technology is waste-free and safe.

The significant vacuum in which these processes take place is responsible for their sterility. The elements of the entire Periodic Table may be employed here, although none of the toxic elements pollute the water or the atmosphere. There are no by-products produced. Water is used only as a heat-transfer agent, and the products from the industrial manufacturing process do not enter the water.

The technology significantly improves the industrial working conditions. It lends itself easily to complete automation, sharply increases labor productivity and makes it possible to reduce the number of maintenance personnel. Work involving this new equipment cannot in any measure be considered to be part of toxic waste-producing industries.

More than ten large-scale manufacturing sets are already in operation in the nation's enterprises. However, more than a few industries have remained indifferent to the new technology. Yet the problem is not attracting separate enthusiasts, but actively involving the Ministries and Departments.

The Ye. O. Paton Institute is working around the clock on the leading edge of science and industry. In response to the rigid requirements of scientific and technical progress, those new technologies which have been discussed at the sessions of the Presidium of the Academy of Sciences USSR are being developed.

12576

CSO: 8144/1603

## RAW MATERIALS RESEARCH IN KAZAKHSTAN

Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 13 Jun 84 p 2

[Article by U. Akhmedsafin and S. Chakabayev: "Basic Development of the Economy"]

[Text] It is well known that mineral resources constitute the basis of the development of the economy. Unfortunately, every year expenditures of means on the searching, prospecting and opening of new ore deposits rise quickly. This sets an extraordinarily important and pressing task for the working out of methodological foundations for metallogenic evaluations and the opening of concrete ore mining regions in compressed time limits on the basis of an all-around geological analysis with maximal concretization of forces and means.

The complex opening of ore mining regions with an appraisal of mineral resources and of ways to utilize them is a new form of organization of scientific and geological prospecting work. It has arisen in Kazakhstan as the logical future development of research on the compilation of the first prognosis maps of central Kazakhstan and the Altai, accomplished in 1953-1956 under the direction of Academician K. I. Satpayev. As an example of the ensuing complex study of the Uspenskaya zone, Mugodzhar, the Chu-Iliiskiy ore belt and other regions, high effectiveness of practical recommendations was demonstrated. In every case, in fact, the result was the establishment of new raw materials bases for nonferrous metallurgy, the exposure of a complex of nonmetallic useful minerals and building materials, and the organization of irrigation for desert territories.

The effectiveness of the new approach caused, first of all, a simultaneous study of all the basic problems of geology, geophysics, metallogenics and economics. This also determined the collective aspect of execution and attraction to the work of production and scientific organizations of various profiles and purposes.

Success was guaranteed also by the fact that scientific projects, conclusions and recommendations were tested operationally in practice by scientists at academic and sectoral institutes and specialists in production organizations.

Research was thoroughly planned and stimulated by precise administrative and scientific management; the ideas and suggestions of scientists were embodied in publications.

The structure of complex research and its effectiveness may be shown by the example of the study of the Chu-Iliiskiy rayon, carried out during 1974-1980. Until the conducting of work, this extensive territory did not present any interest with respect to many useful minerals.

A unified geological map was compiled according to a newly worked out legend; a regional geophysical study of the deep structure of the territory was accomplished; structural-formational division into districts, an ore-formation analysis and other special metallogenic and mineralogical research studies were carried out, including the utilization of computers.

Geological-technological research was combined with geological-economic studies for an evaluation of the quality and complex utilization of raw materials.

As a result of the work, there was development and completion of large-scale testing of models of the composition and evolution of the earth crust, which was a major result of fundamental research in geology and metallogenics. On the basis of this working out, applied goals were resolved for the special metallogenics of ferrous, nonferrous, rare and precious metals, mineral chemical raw materials, building materials and other useful minerals. There was also established the central character of the distribution of concentrations of metals connected with the formation of deposits in the stage of tectonic-magmatic activation of the territory, as well as definite parameters and prospects for ore centers and the periodicity of their appearance in definite structures.

A distinctive feature was the use of mathematical methods and computers for the prognosis of useful minerals. At the first, early stage, the prognosis was accomplished by the utilization of available information. The earmarked prospective areas were examined and studied in the process of carrying out work. On the basis of new factual material, a quantitative prognosis of resources was accomplished in the second stage. A similar type of two-stage geological-mathematical method was realized for the first time and yielded significant results. A new prospective belt appeared on the map of Kazakhstan.

Actually, we have a new qualitative level of geological research which responds to the tasks of scientific and technical progress. A scientific basis and working out of new methodology and its practical testing took more than two decades. It was begun on the basis of the Uspenskaya tectonic zone and after that the Mugodzhar and Zharma-Saurskiy regions followed where, thanks to the creative search by scientists, new ore belts appeared, as well as new raw materials bases. The prognosis work in the Chu-Iliiskiy region was crowned with the establishment of new raw materials bases for a number of useful minerals.

The obtaining of theoretical and applied results plays an important role in the new level of generalization in the geology and metallogenics of Kazakhstan. The experience of work in Chu-Iliisk problems, where the most thorough methodology was applied, is used at the present time in conducting analogous study in the Karatau, Kokchetavskiy and Balkhashskiy regions, as well as for work outside Kazakhstan.

The highly perfected form of reciprocal scientific and production activity discovered by the geologists of Kazakhstan has permitted the consequent realization of the introduction of the newest scientific and technical achievements in practice with minimal expenditure of time and means.

The authors of a cycle of published work, the Kazakhstan geologists and geophysicists A. A. Abdullin, G. N. Shcherba, T. A. Akishev, Yu. A. Zaytsev, V. P. Konyayev, V. A. Narseyev, Ye. I. Patalakha and L. V. Favorskaya, were deservedly recommended for the competition for the USSR state prize in 1984. Their activity, embodied in works whose scientific and practical value is extremely high, is an example of the creative realization of the resolution of the 26th CPSU congress on the acceleration of the utilization of scientific and technical progress. These works assist in the material strengthening of the mineral and raw materials base of the country.

12249

CSO: 1842/117

## MORE EFFICIENCY AND COOPERATION NEEDED IN THE DEVELOPMENT OF UDOKAN

Moscow PRAVDA in Russian 24 Jun 84 p 2

[Article by M. Matafonov, First Secretary of the Chita Obkom of the CPSU:  
"In Quest of the Treasures of Udokan-Coordinated Development for the Eastern  
Regions."]

[Text] Last year in the early morning hours of the November 7th holiday the first work train arrived at the Novaya Chara station in the north of the Chita Oblast. A group of construction workers from the Baikal-Amur Main Line had laid track to the area of the Udokan copper deposits, the largest known in our country.

In commemoration of the 67th Anniversary of the October Revolution the last "golden" link of BAM will be laid on the Chita section and through train traffic from Baikal to the Amur will commence. The period of active exploitation of natural resources of this distant region will begin.

The construction of BAM established the necessary prerequisites for the exploitation of the Udokan deposits. Along the whole course of the rail line intensive scientific exploration has begun. The Presidium of the Academy of Sciences of the USSR has set up a scientific council on the problems of economic exploitation of the BAM area. All-union scientific-practical conferences have been conducted at which the future of Udokan, among other questions, has been discussed.

An order was issued by the minister of nonferrous metallurgy about the construction of an experimental-industrial complex on the basis of the Udokan Ore Dressing Combine during the years 1975-1980. Planning organizations of the Ministry of Nonferrous Metallurgy developed the project. However, the project went no further. Every year meetings are conducted on various levels and many good recommendations and decisions are made; however, the Ministry of Nonferrous Metallurgy has not taken any concrete steps in the exploitation of Udokan.

Taking into consideration the importance of the problem, the Siberian section of the Academy of Sciences of the USSR organized the Institute of Natural Resources in Chita and entrusted to it the coordination of operations of the program "Copper Ores of Udokan." During the first years of the institute's

activity it was possible to conduct a series of explorations and scientific operations. The Siberian section of the Academy of Sciences of the USSR in agreement with ministries and organizations put together a single plan and entrusted the coordination of its operation to its institute in Chita. However, in practice the institute has been unable to accomplish this coordination because it doesn't have the legal authority necessary. In addition, it is still quite weak, and the rate of its staffing and equipment acquisition is low.

There is no doubt that in the area of the northern Trans-Siberian rail route a powerful industrial belt consisting of separate regional production complexes and industrial units in time, as is planned, will be established. However, problems are still being solved too slowly in the northern part of our oblast.

Meanwhile, geologists are continuing their detailed exploration of the flanks and the deep beds of the Udokan deposits. Immediately adjacent to them large deposits of iron ore, coking coal, underground waters, rare metals, cryolite, high clay-content soil and other useful minerals have been uncovered and to various degrees prospected. Seventeen deposits of building materials have been turned over to the construction organizations of Glavbamtroi (the central construction authority for BAM). From the most positive point of view a whole range of natural riches and their high concentration characterize this region. Of course, the locating of industrial sites is complicated by permafrost and higher than normal seismicity. However, the experience of the construction of the Baikal-Amur Main Line showed that these conditions would not be a hindrance to the rapid transformation of the kray.

The obkom of the CPSU never loses sight of the problems of exploiting the natural resources of the northern part of the oblast. They have been discussed on many occasions at plenary sessions and meetings of the buro and the secretariat. A discussion of the operations of the organization Chitageologiya (Chita-geology), for example, once became a topic in a thorough and useful conversation that was going on. The talk was about mineral prospecting in the BAM area. As a result of the conversation, the detachments of geologists working at Udokan were augmented.

In January of this year at an oblast party reporting-election conference delegates spoke out with alarm concerning the slow exploitation of Siberian underground treasure. Consequently, in its decree the conference obligated the obkom of the CPSU to take measures, in particular to see to it that the drawing up of a technical plan for the exploitation of the Udokan deposits was completed in 1985.

We entrust sections of work connected with the exploitation of natural resources to Communists, work-tested and competent people with a high sense of responsibility for the task at hand. In this regard we will mention the chief geologist of the Udokan Geological Exploration Expedition Vladimir Stepanovich Chechetkin. He participated in the exploration of the first phase of the deposits. He has rich experience as one of the authors of the report on the protection of Udokan reserves. Under his leadership the active study of the mineral resources of the Udokan Ridge is now being conducted.



On the initiative of the party obkom a special meeting of the Academic Council on the Problems of the Baikal-Amur Main Line of the Siberian section of the Academy of Sciences, USSR took place. One of the fundamental questions under discussion was how to put Trans-Baikal copper at the disposal of the economy more quickly.

In October 1982 an inter-organization commission of two union ministries, the Ministry of Geology and the Ministry of Nonferrous Metallurgy, developed the idea of the transfer-inspection of reserves of the Udokan deposits for industrial exploitation. The institute Giprotsvetmet (State Institute for the Planning of Enterprises in Nonferrous Metallurgy) developed a plan of the general configuration and development of the Udokan Mining-Dressing Integrated Works. Construction sites for the main buildings were selected. Thus, the Udokan ore region was highly prepared for planning work and the exploitation of the deposits. However, this is not enough. The fact is that to date there is still no confirmed general plan or model of the region's transport communications.

In order to speed up construction it is apparently necessary to approve a model of the transport communications and to issue working plans in advance of the approval of the completed plan of the complex as a whole. A transport infrastructure is also necessary for Udokan. From the station Chara, near which a city will grow, to the mining-dressing integrated works about 40 kilometers of rail line must be laid. The construction workers of BAM already offered their help. However, the Ministry of Nonferrous Metallurgy has been moving slowly. Neither has the question about the general contractor for the construction of the Udokan Mining-Metallurgical Complex been resolved. In our opinion Bratskgesstroi (Bratsk Hydro-Electric Plant Construction) could become such an organization.

Since the volume of capital investment in the construction of the Udokan complex will be very substantial, it would behoove Gosplan, USSR to seek out special purpose funds and to determine the periods and rates of their allocation, having already provided for the financing of the complex on a separate line. The construction of an experimental-industrial installation at which it would be possible to verify the calculations and computations of scientists under real conditions of the region is an urgent task.

Udokan ores contain many by-product components, the total value of which may even be more than the value of the copper itself. However, the problem of their extraction will be resolved only when appropriate technology appears. It also will have to pass experimental-industrial verification at Udokan.

Favorable circumstances for the resolution of the problems named are now developing. In connection with the completion of the laying of the rail route the productive forces of the leading trusts of Glavbamstroi will begin to be available. They are capable of solving complicated problems. It would be right to utilize them on the construction of spur rail lines and motor vehicle roads leading to the deposits of copper.

Questions about the power supply for the industrial center must be decided more quickly. Alternatives for the delivery of electric power, which include the

Bratsk GES, the Neryungri GRES and the Moksk GES, are still at the discussion stage. There are no recommendations for supplying fuel and energy using either Chitkandinsk or Apsatsk coal. It seems that the proposals of Yakutsk scientists about the transfer of petroleum and gas by pipeline along the BAM right of way deserves attention.

In exploiting the Udokan deposits--the first of a future industrial complex--efforts must be made to avoid errors, which in the past have been made in the planning and construction of complexes established according to particularly bureaucratic principles. Really, is it economical if each ministry designs its own heating supply system, its own power plant and its own plant for the manufacture of building structures? Due to the creation of duplicate systems, construction is made more expensive and the management of the complex is made more complicated.

This is why it is so important to develop with perspective a general model and regional planning of the development of the whole complex. Given the existing inter-departmental barriers not a single ministry will accomplish this task; these ministries will be limited to setting up plans only for their own work.

The planning of the city of Udokan itself, in which some 100,000 people will live, ought to be speeded up. During the construction of residential blocks a series of important economic, engineering, construction and ecological problems related to the maintenance of comfortable conditions for people and the preservation of the natural surroundings will have to be solved. Because Udokan has been given the status of a construction project of all-union importance, it is important in the exploitation of the region to assign to it skilled personnel.

The copper of Udokan is a national treasure. Everything possible must be done to put it to the service of the people more quickly.

8750

CSO: 1842/122

## MEETING ON PROBLEMS OF STRENGTH OF MACHINE MATERIALS

Baku VYSHKA in Russian 1 Jun 84 p 3

[Text] What kinds of possibilities exist for developing effective methods for heightening the strength of various materials? How to lengthen the safe-operation time of structures used in the petroleum-extracting industry, machine building and other industries?

These problems were discussed at a joint meeting of the scientific methods commission on standardization in the field of failure mechanics of the USSR State Standards Committee's scientific and technical council, and the USSR State Committee for Science and Technology, State Planning Committee and Academy of Sciences. The meeting was held at the Azerbaydzhan Academy of Sciences' Institute of Mathematics and Mechanics in Baku, and it ended May 31.

The attention of scientists and specialists from Moscow, the Ukraine and Azerbaydzhan was focused on timely questions of contemporary theory of strength, and of the carrying-out of basic research and applied developments that promote longer service life of metals, plastics and other materials, pipelines, and oil-field and other equipment.

The participants in the meeting, which lasted three days, visited a number of industrial enterprises of Baku, where discussion of questions of the strength and failure of machines and equipment was continued.

FTD/SNAP

CSO: 1842/119

## ZINC-COATED STEEL WIRE FOR CABLES USED IN SUPERDEEP DRILLING

Moscow SOVETSKAYA ROSSIYA in Russian 24 Jun 84 p 1

[Article by V. Drobotov, Volgograd]

[Text] A consignment of unique, high-strength steel wire with a zinc coating has been sent from Volgograd to a cable plant in Tashkent. Load-supporting geophysical cables 12,000-15,000 meters long are manufactured from this wire. Petroleum-industry workers use these cables in the drilling of superdeep boreholes.

This innovation was developed by specialists of a laboratory of the Volgograd Steel Wire and Rope Plant. The zinc-coated steel wire, which is in great demand, has been put into production in one of this plant's newer shops, which is outfitted with modern equipment. The cable makers have been awarded a silver medal of the Exhibition of National Economic Achievements for their creative undertaking.

FTD/SNAP

CSO: 1842/119

ROUND-BILLET MILL AT UZBEK STEEL WORKS

Tashkent PRAVDA VOSTOKA in Russian 3 Jul 84 p 1

[Excerpt] The "300" rolling mill which has been built at the Uzbek Metallurgical Plant has begun service. The complex's first phase, which is rated for production of 600,000 tons of round billets annually, has been accepted for operation.

The "300" mill is the final unit of the electrometallurgical production facility which has been under construction in Bekabad for a number of years.

The workers of the Uzbek Metallurgical Plant have pledged to put this new facility into operation at full capacity during the coming year. In the meantime, construction work is continuing in Bekabad. The second phase of the "300" mill is to be put into operation by the end of the 5-year plan. Following the completion of this phase, the mill will be able to produce 1,150,000 tons of products a year.

FTD/SNAP

CSO: 1842/119

IMPROVED TECHNOLOGY FOR INDUCTION MELTING AND CASTING OF PIG-IRON

Vilnius KOMSOMOL'SKAYA PRAVDA in Russian 12 Jun 84 p 2

[Article by V. Zhutautas]

[Excerpt] Products of the "Tsentrolit" Plant of Kaunas are supplied to more than 100 enterprises.

"A system for continuous measurement of the temperature in induction furnaces for the casting of pig iron has been introduced as a result of collaboration with the Ukrainian Academy of Sciences' Institute of Casting Problems," related Eval'das Mayauskas, director of this plant. "It has now become possible not only to monitor the temperature in these furnaces but also to maintain optimum temperature over the course of the entire melting process. Formerly, 7.2 percent of the metal was lost due to burn-up; now only 3.8 percent is."

An efficient process for melting artificial pig iron has also been introduced at the enterprise.

"Tsentrolit" was aided in introducing a synthetic induction melting process for pig iron by specialists of the Institute of Casting Problems, the chair of casting of the Leningrad Polytechnical Institute, the All-Union Casting Technology Design Institute, the Moscow Institute of Steel and Alloys, the "Stankolit" plant of Moscow, and the Leningrad Machine-Tool Building Production Association. The casting laboratory of the Kaunas Polytechnical Institute also made a solid contribution.

FTD/SNAP

CSO: 1842/119

UDC 669.017:539.43

# THEORY OF DISCRETE GROWTH OF FATIGUE CRACKS IN METALS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 84  
(manuscript received 2 Nov 82) pp 159-163

SHANYAVSKIY, A. A., Moscow

[Abstract] The phenomenon of fatigue failure of metals is related to the fact that every cycle of changing load at crack surfaces brings plastic deformation and violations of continuity. The author attempts to connect parameters of stress in metal fracture surfaces with discrete, quasibrittle progression of fracture length within the zone of plastic deformation in every cycle of external load variation, assuming that such stresses correspond to a critical energy level and that local stress at the end of fractures is independent of the type and conditions of the external load. Mathematical calculations are presented to show that this discrete and continual process of fracture growth takes place in correlation with load intensity in accordance with a universal fatigue constant earlier proposed by V. S. Ivanova [TSIKLICHESKAYA VYAZKOST' RAZRUSHENIYA METALLOV I SPLAVOV, Moscow, Nauka, 1981 p 168]. Figures 1, references 16: 11 Russian, 5 Western.  
[119-12131]

UDC 669.15'781

# EFFECT OF COMPOSITION AND GEOMETRIC DIMENSIONS ON DURABILITY PROPERTIES OF AMORPHOUS-FILAMENT MICROCONDUCTORS

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 84  
(manuscript received 6 Apr 82)

BASHEV, V. F. and MIROSHNICHENKO, I. S., Dnepropetrovsk

[Abstract] Amorphous alloys are known to have superior durability compared to corresponding crystalline alloys. The present article reports on effects of composition and geometric dimensions of amorphous filament microconductors based on Fe-P and F-C-B alloys, on mechanical properties such as stretch and stress failure. High-speed cooling of such microconductors promoted formation of metastable structures. Increasing boron content from 4.5 to 17% was found to increase durability from 2900 to 4200 MPa, surpassing crystalline variants

by a factor of 2.5. Stretch of 2-3% was registered; this also surpassed relative stretch for austenite-cementite microconductors. Brittle failure was similar for the two types. With reduced dimensions, the destructive role of defects grew, so that at about 5 mcm the amorphous alloys had less durability than corresponding crystalline microconductors. Figures 3; references 6: 2 Russian, 4 Western.  
[119-12131]

UDC 541.12.13.01.4:533.15:542.46

#### BEHAVIORAL FEATURES OF SULFIDE SMELTS OF IRON, COBALT AND NICKEL AT HIGH TEMPERATURES

Moscow IZVESTIYA AKADEMII NAUK SSSR: METALLY in Russian No 3, May-Jun 84 (manuscript received 28 Jan 81) pp 67-70

BRYUKVIN, V. A., KAPUSTIN, O. A. and TSYBIN, O. I., Moscow

[Abstract] In a wide range of temperatures and composition, sulfide smelts of transitional metals have a tendency for dissociative vaporization of sulfur, resulting in metallization of the smelt. The present article reports on study of the chemical bond's role in this process. Thermogravimetric analysis in a neutral gas medium of nitrogen was used to evaluate FeS, CoS and Ni<sub>3</sub>S<sub>2</sub>.

Microscope studies established the absence of interaction of smelts with the crucible, and mass spectrometry did reveal any appreciable amounts of metal in the gas-vapor phase. Thus, weight changes in the smelts were isolated to desulfuration processes. The tendency for all three compounds to undergo an isothermal process resulting in lower sulfur content is discussed. The existence of a high-temperature mackinawite metastable phase, containing saturation levels of sulfur, is proposed. Under identical thermal conditions, the dissociative capability of the transitional metals followed the ascending order Fe-Ni-Co, so that up to 1500°C, iron and nickel sulfides dissociated, metallized and shifted to the composition range corresponding to eutectics of the original systems. Figures 1; references 9: 6 Russian, 3 Western.  
[119-12131]

#### WORK ON ALLOYS WITH SHAPE MEMORY

Vilnius KOMSOMOL'SKAYA PRAVDA in Russian 23 Jun 84 p 3

T. Komarova

[Abstract] The brief article records a conversation with Doctor of Technical Sciences Yuriy Kovneristyy regarding progress of work by the USSR Academy of Sciences' Institute of Metallurgy imeni Baykov on the development of materials possessing shape memory. Unusual alloys possessing this property and processes for producing them on an industrial scale have been developed at the institute.



Kovneristyy mentioned that more than 200 types of alloys with shape memory have now been developed, and he demonstrated the use of changes of temperature to alter and restore repeatedly the shape of objects made of these alloys. The effect of thermally controllable change of shape manifests itself most vividly in nickel-titanium compounds, according to Kovneristyy.

FTD/SNAP

CSO: 1842/119

#### VAPOR-PHASE TECHNOLOGY ADVANCES IN SPECIAL ELECTROMETALLURGY

Moscow IZVESTIYA in Russian 26 May '84 p 2

Ye. Manucharova, correspondent

[Abstract] The article describes the kinds of advances that have been afforded by so-called vapor-phase technology in special electrometallurgy, which has been pioneered by the Ukrainian Academy of Sciences' Institute of Electrical Welding imeni Paton. It is noted that Boris Alekseyevich Movchan, member of the Ukrainian academy and head of a large department of the institute, gave a report on this technology at a recent meeting of the presidium of the USSR Academy of Sciences. The academy's presidium has a scientific council on the problem "New Processes for Obtaining and Working Metallic Materials" which is headed by academician B. Ye. Paton and which coordinates research on this technology and its industrial applications.

The article describes how the technology utilizing electron beams to vaporize metals and nonmetals such as ceramics in a vacuum and their subsequent deposition produces materials possessing unique properties. For example, it is said that plasticity can be imparted to brittle metals such as chromium to the extent that a sheet of chromium made by the technology can be folded twice at room temperature, like a sheet of paper. It is recalled that among the first practical applications that Movchan's department developed was the protective coating of gas-turbine blades. The service life of turbines of gas-pumping stations was increased by as much as five times as a result.

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#### SCIENCE, INDUSTRY LEADERS PRAISE ELECTRIC WELDING INSTITUTE ON ANNIVERSARY

Kiev RABOCHAYA GAZETA in Russian 18 May 84 p 1

[Abstract] The article reports on an award ceremony marking the 50th anniversary of the Ukrainian Academy of Sciences' Institute of Electric Welding imeni Paton. The institute was presented with the order of the October Revolution at the ceremony in Kiev on May 17.

The text of a speech by V. V. Shcherbitskiy, member of the Politburo of the Central Committee of the Communist Party of the Soviet Union and first secretary of the Central Committee of the Communist Party of the Ukraine, is given. Shcherbitskiy praised the institute's working style, saluted its contributions to the advancement of welding and special electrometallurgy, mentioned the names of outstanding personnel of the institute, and discussed tasks for further improving the performance of this and other research organizations of the Ukrainian republic. He noted that the institute employs 8,400 persons, including 778 scientific workers. Among them are 49 doctors of sciences and 350 candidates of sciences.

Summaries are given of the remarks of other speakers at the ceremony, including A. P. Aleksandrov, president of the USSR Academy of Sciences; academician G. A. Nikolayev, president of the Moscow Higher Technical School imeni Bauman; and V. A. Izbekov, general director of the "Bol'shevik" production association of Kiev. Academician B. Ye. Paton, director of the electric welding institute, noted in his expressions of thanks for the honor that in addition to the institute itself, its R&D complex takes in a design and technological bureau, an experimental plant, a test facility for explosive working of metals, and welding-equipment, welding-materials and special-electrometallurgy pilot plants. V. T. Saykin, general director of the "Automotive Plant imeni Likhachev" Production Association, praised results of electroslog welding and casting and other advanced methods and processes which have been introduced in the automotive industry with the help of institute personnel. V. V. Ryumin, Pilot-Cosmonaut of the USSR, praised the institute's contributions to the space program, particularly its development of the "Ispartel'" metal-plating units for "Salyut" orbiting stations. Ryumin mentioned that the institute is now developing new welding methods for large structures of future space stations.

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DISTRIBUTION OF BORON, TUNGSTEN, TITANIUM AND COBALT IN BORIDED HARD ALLOYS

Sverdlovsk FIZIKA METALLOV I METALLOVEDENIYA in Russian Vol 57, No 4, Apr 84  
(manuscript received 6 May 83) pp 713-718

BERZINA, I. G., GUSEV, E. B., ZAKHOROV, B. V., FEDINA, G. N. and FEDIN, V. M.,  
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[Abstract] A study is made of the distribution of boron in the surface layer of borided sintered hard alloys type VK6, T5K10 and T15K6. The process of boriding specimens consisting of hard alloys was performed in a powdered mixture of preliminarily dried boron carbide plus 30% cryolite in a crucible after blowing helium through the mass once with subsequent evacuation at 1050 and 900°C for 2 hours. It is found that the boride layer in the alloys studied is formed of compounds of boron with cobalt with the major components, tungsten and titanium, sinking into the depth of the hard alloy. The distribution of boron, tungsten, titanium and cobalt in the boride layer, transition zones and

base material is determined. The thickness of the boride layer, transition zone, distribution of boron in these zones and their microhardnesses differ in different alloys as a function of the boriding conditions. Boron is most uniformly distributed at 900°C. The maximum microhardness is observed in the zone of quasiuniform distribution of boron with significant redistribution of the major elements of the hard alloy. Figures 6; references 8: 6 Russian, 2 Western.  
[105-6508]

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